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**Type of Organization:** College or University

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**Project Title:** Predicting effects of Galerucella on purple loosestrife

**Project Category:** Exotic Species

**Rank by Organization (if applicable):** 0

**Total Funding Requested (\$):** 19,595 **Project Duration:** 2 Years

**Abstract:**

Insect herbivores are presently being released throughout the United States in an effort to control purple loosestrife, an exotic, invasive wetland plant. Presently however, we do not know what dose of an herbivore is required to stop loosestrife and return our wetlands to a pristine state. Consequently, releases may be excessive at some sites, wasting resources, while at other sites loosestrife may continue to spread. We propose to use resource competition theory to determine the level of herbivory required to control loosestrife at a given site based on simple comparisons of resource availability (light, nitrogen, phosphorus) between loosestrife and its local native competitors. Because plants compete for limiting resources, we will be able to predict the ultimate effect of herbivory on competition between loosestrife and native species from short-term changes in resource availability. We propose to test this methodology at Presque Isle State Park, Erie County, Pennsylvania. This method could then be applied to loosestrife infestations throughout the Great Lakes region where loosestrife continues to be a major exotic pest.

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**Geographic Areas Affected by the Project**

**States:**

<input type="checkbox"/> Illinois	<input type="checkbox"/> New York
<input type="checkbox"/> Indiana	<input checked="" type="checkbox"/> Pennsylvania
<input type="checkbox"/> Michigan	<input type="checkbox"/> Wisconsin
<input type="checkbox"/> Minnesota	<input type="checkbox"/> Ohio

**Lakes:**

<input type="checkbox"/> Superior	<input checked="" type="checkbox"/> Erie
<input type="checkbox"/> Huron	<input type="checkbox"/> Ontario
<input type="checkbox"/> Michigan	<input type="checkbox"/> All Lakes

**Geographic Initiatives:**

<input type="checkbox"/> Greater Chicago	<input type="checkbox"/> NE Ohio	<input type="checkbox"/> NW Indiana	<input type="checkbox"/> SE Michigan	<input type="checkbox"/> Lake St. Clair
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**Primary Affected Area of Concern:** Presque Isle Bay, PA

**Other Affected Areas of Concern:**

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***For Habitat Projects Only:***

**Primary Affected Biodiversity Investment Area:**

**Other Affected Biodiversity Investment Areas:**

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**Problem Statement:**

Purple loosestrife (*Lythrum salicaria*) currently invades marshes and wet meadows throughout the Great Lakes drainage. Loosestrife forms dense monospecific stands, displacing native flora and fauna. Presently, the USDA Animal and Plant Health Inspection Service (APHIS) is rearing insect herbivores (the leaf-feeding Chrysomelid beetles *Galerucella californiensis* and *G. pusilla*) in massive numbers for release into loosestrife populations in an attempt to biologically control loosestrife. However, at present the intensity of insect herbivory required to reverse the outcome of competition between loosestrife and native species, across the wide range of environments that loosestrife has infested, is unknown. Without adequate control, loosestrife will continue to spread throughout the Great Lakes region.

We propose the application of resource competition models as a methodology to identify the environmental conditions which allow loosestrife to out-compete native species and, more importantly, to quantify the effect of insect herbivores (*Galerucella*) on loosestrife across a range of environmental conditions. Resource competition theory is based on the simple idea that plants compete indirectly through consumption of limiting resources such as light and nitrogen. The species that reduces the availability of the limiting resource the most, and can subsist on that low level of limiting resource, is predicted to competitively exclude other plant species. To control loosestrife, herbivorous insects must reduce loosestrife's ability to compete for limiting resources.

We currently have underway in Crawford County, northwestern Pennsylvania, a common garden experiment designed to apply this methodology to the loosestrife problem. By growing loosestrife and its frequent competitor, broad-leaved cattail (*Typha latifolia*), in monoculture, we are quantifying the effect of each species on the availability of limiting resources. Similarly, by including a range of insect herbivore densities, we can measure the effect of the herbivore on loosestrife's ability to compete for limiting resources, and hence quantify the intensity of herbivory required to reverse the outcome of competition between loosestrife and cattail. Simultaneously, we are growing loosestrife and cattail in direct competition with each other to test the ability of relative resource availability to predict the outcome of competition. In this way, we can determine both the site conditions favoring loosestrife establishment and the level of biological control agent required to control loosestrife.

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We propose to apply this methodology at Presque Isle State Park, an area severely impacted by purple loosestrife. Presque Isle State Park is an ideal locale to develop this methodology because it contains several loosestrife infestations across a range of habitats, from infertile dune slacks to highly fertile marshes.

#### **Proposed Work Outcome:**

We will obtain adult *Galerucella* beetles from USDA APHIS and release them at several sites at Presque Isle. We will then monitor herbivore density, loosestrife density, light availability and soil resource availability (nitrogen and phosphorus) within the loosestrife stands. By comparing, within each site, the herbivore density required to control loosestrife with the relative difference in resource availability between loosestrife and its competitors, we can develop a clear protocol for determining the herbivore density required for control at any given site. We will then be able to collect simple site index parameters (the resource availability differential between loosestrife and its local competitors) and estimate the level of herbivory required to control loosestrife at a given site. In this way we can apply this methodology to loosestrife infestations throughout the Great Lakes region and beyond.

#### **Monitoring resource availability and loosestrife density**

In May and August of years one and two we will collect resource availability data from four sites at Presque Isle State Park. At each site we will establish 12 1m<sup>2</sup> sampling quadrats, six in loosestrife stands and six in stands of adjacent competing species. We will collect light availability with a Li-Corr line quantum sensor at ground level, and at 50 cm intervals to the top of the canopy. We will also collect two soil cores per sampling quadrat, which will then be pooled for analysis. The soil samples will be analyzed for ammonium, nitrate, and phosphate. Concurrently, we will quantify loosestrife stem density and height in the sampling quadrats described above. These samples will allow us to measure changes in resource availability and loosestrife density due to application of the biocontrol agents.

#### **Application of biocontrol agents**

*Galerucella* beetles will be released as adults in May-June of years 1 and 2. Beetles will be obtained through an ongoing partnership with USDA APHIS. In July and August of years 1 and 2 we will census *Galerucella* densities and levels of herbivore damage in each sampling quadrat, following the 'purple loosestrife monitoring protocol' developed by B. Blossey at Cornell University.

#### **Project benefits**

Benefits from this project are two-fold. First, we will develop a protocol, based on simple site index parameters of resource availability, to estimate the required density of *Galerucella* to control loosestrife on a site-by-site basis. This will allow efficient use of limited quantities of these biocontrol agents and timely control of loosestrife. Secondly, this project will mount a concerted biocontrol campaign against purple loosestrife at Presque Isle State Park.

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**Project Milestones:**

**Dates:**

Project Start	05/2000
Pre-release survey	05/2000
First Galerucella release	05/2000
First post-release survey	08/2000
Second Galerucella release	05/2001
Third post-release survey	08/2001
Evaluation and protocol development	09/2001
Project End	09/2001

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☐ Project Addresses Environmental Justice

**If So, Description of How:**

☐ Project Addresses Education/Outreach

**If So, Description of How:**

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**Project Budget:**

	<b>Federal Share Requested (\$)</b>	<b>Applicant's Share (\$)</b>
<b>Personnel:</b>	14,000	9,000
<b>Fringe:</b>	0	0
<b>Travel:</b>	500	0
<b>Equipment:</b>	0	19,000
<b>Supplies:</b>	0	200
<b>Contracts:</b>	0	0
<b>Construction:</b>	0	0
<b>Other:</b>	0	0
<b>Total Direct Costs:</b>	14,500	28,200
<b>Indirect Costs:</b>	5,095	0
<b>Total:</b>	19,595	28,200
<b>Projected Income:</b>	0	0

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**Funding by Other Organizations (Names, Amounts, Description of Commitments):**

McKinley Fund 2300  
Pennsylvania Academy of Sciences 500  
Sigma Xi 700  
USDA National Biological Control Institute 11000

Funds from USDA NBCI, and McKinley are committed to the common garden experiment described above. Funds from Sigma Xi and PAAS have been allocated to preliminary field work for the present proposal. Funds from all four sources are being sought for 2000-2001.

Salary for W. Carson and a stipend for D. Bunker will be provided by the university of Pittsburgh. Equipment and supplies for light measurements and soils analyses will be provided by the Carson and Chase labs, respectively, of the University of Pittsburgh.

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**Description of Collaboration/Community Based Support:**

We are working in cooperation with the PA Game Commission, Presque Isle State Park, the Presque Isle Conservancy, and numerous private land owners to monitor loosestrife stands and biocontrol effects. The Pennsylvania Department of Agriculture, Bureau of Plant Industry has granted us a permit to grow loosestrife for research purposes. USDA APHIS has agreed to supply Galerucella beetles.